NON-PUBLIC?: N
ACCESSION #: 8812050217
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Shearon Harris Nuclear Power Plant Unit 1 PAGE: 1 OF 5

DOCKET NUMBER: 05000400

TITLE: Manual Reactor Trip Upon Loss of Main Feedwater Due to Trip of Heater Drain Pumps
EVENT DATE: 10/30/88 LER #: 88-032-00 REPORT DATE: 11/29/88

OPERATING MODE: 1 POWER LEVEL: 098

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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Senior Specialist - Regulatory Compliance

COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE TO NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On October 30, 1988, the plant was operating in Mode 1 at 98% power. At 18:26:47 hours, the "B" Heater Drain Pump tripped causing an automatic turbine runback. Approximately 25 seconds later, the "A" Heater Drain Pump tripped. Due to the rapid load reduction and sudden decrease in feedwater flow, the "B" Condensate Booster Pump tripped on high discharge pressure at 18:30:36. The control operator tripped the "B" Main Feedwater Pump at 18:31:00, and the "A" Main Feedwater Pump automatically tripped at 18:32:32, resulting in a loss of all feedwater flow. The control operator manually tripped the reactor at 18:32:44 and stabilized the plant in Mode 3.

The event was initiated by the trip of the Heater Drain Pump which was attributed to a plywood cover inadvertently left inside Feedwater Heater 3A following maintenance. In addition, the automatic turbine runback did not function as expected by the operators. This hindered their ability to stabilize the plant and avoid a reactor trip. The turbine runbacks were investigated and the response was in accordance with the design. The operators were retrained

with the information obtained from the investigation of the runback functions. The plywood cover was removed from the feedwater heater.

END OF ABSTRACT

DESCRIPTION:

The plant was operating normally in steady state conditions at 98% thermal power and producing 877 net MWE. All significant plant control systems were in automatic, and all Digital Electro-Hydraulic (DEH) Control System (EIIS:TG) feedback loops were operational. The plant was in the process of returning to full power operation following refueling. The 90% thermal power level was reached about 1700 on October 29, 1988. The ascension to full power began about 1410 on October 30. As the power increase began, the "Low Delta P/Low Flow" alarm was periodically received for "B" Heater Drain Pump (EIIS:SN:P). The "Low NPSH" alarm was actuating at regular intervals as power approached 98%. By 1620, on October 30, power was stabilized at 98%. There was no readily apparent reason for the Heater Drain System fluctuations.

This transient was the result of a series of complex plant interactions. At 1826 the "Low Delta P/Low Flow" alarm actuated and "locked in." The "Low NPSH" alarm actuated, cleared, and actuated again. At 18:26:47 the "B" Heater Drain Pump (HDP) tripped. This started a turbine runback. The control operator expected the runback to stop at 86% turbine power.

Approximately 25 seconds after the trip of the "B" HDP, the "A" HDP also tripped. The initial runback was still in progress due to overshoot caused by the turbine's (DEH) Control System (EIIS:TG), Reactor power at the time of the "A" HDP trip was, approximately 93% as indicated by the Nuclear Instrumentation System, and approximately 70% turbine power. The turbine runback stopped when turbine power was approximately 54% at 18:27:32. As a result of the turbine load rejection, the Steam Dump Control System load rejection controller was armed and attempting to limit the increase in Reactor Coolant System average temperature caused by the mismatch between reactor power and turbine load. The Steam Dump valves to the condenser closed at 18:27:17 indicating that Reactor Coolant System average temperature was within 3 degrees of the reference value from turbine first stage pressure. Reactor power remained near 70% for approximately the next 3 minutes.

During the transient, the Condensate Booster Pumps speed controller shifted to manual control due to discharge pressure increasing above a preset pressure. This was caused by the decrease in feedwater flow and apparent overshoot by the Condensate Booster Pumps speed controller. The control operators were controlling steam generator water level by manually controlling the feedwater

regulating valves, and were controlling the Main Feedwater Pump (EIIS:SJ:P) suction pressure by manually adjusting Condensate Booster Pump speed. However, the "B" Condensate Booster Pump (CBP) (EIIS:SG:P) tripped on high discharge pressure at 18:30:36. The operator expected the corresponding Main Feedwater Pump (MFP) to trip. When it did not, the operator then manually tripped the "B" MFP at 18:31:00, because the operators were trained that an automatic MFP trip should have resulted.

DESCRIPTION (continued)

Based on reactor power, the operators were expecting another turbine runback upon the trip of the "B" MFP, but it did not occur. The runback did not occur because the runback is based on turbine load, and it was already low enough to prevent the runback. An operator, believing that the automatic runback failed to occur, began a manual turbine runback, and started both motor driven Auxiliary Feedwater Pumps (EIIS:BA:P). Steam Dump to the condenser was again actuated, and the manual runback caused a reactor power cha
ge from
approximately 70% to 60%. The Steam Dumps actuated from 18:32:02 to 18:32:18. During this runback, the output of the "A" CBP was controlled manually to maintain discharge pressure. The "A" MFP suction pressure subsequently decreased to approximately 314 psig, and at 18:32:32, automatically tripped resulting in a loss of all main feedwater flow. Following these events, the reactor was manually tripped at 18:32:44, and the plant was stabilized in Mode 3. Reactor power at the time of the trip was approximately 58%.

CAUSE

There were two causal factors for this event. The loss of the heater drain pumps initiated the event, and the unexpected response of the DEH Control System during the turbine runback contributed to the event.

The initial problems relating to the Heater Drain Pumps NPSH were attributed to an abnormal pressure drop across Feedwater Heater 3A, caused by a plywood cover that had been inadvertently left inside the heater following maintenance activities during the previous refueling outage. The cover had been used to partially cover the feedwater inlet to the heater to allow workers a platform to stand on. Generally, individuals are allowed to follow good work practices on non-safety systems without detailed work procedures or inspection hold points. The failure to remove the plywood cover was a personnel error in failing to implement proper work practices. Procedure MMM-011, "Cleanliness and Housekeeping," recommends a written record of the entry and exit of personnel and tools. The use of the record, however, is elective based on the judgment of the job supervisor. The basic thrust of MMM-011 is to assure that the conduct

of a specific job does not degrade the cleanliness of a system.

The cover partially blocked the feedwater flow through the 3A & 4A heaters, and in turn, increased the flow through the 3B & 4B heaters. The increased flow through 3B & 4B heaters caused increased condensed steam flow on the 4B heater shell side and decreased shell pressure. The "B" HDP takes suction from the 4B heater shell side. The heater level control system controls to a fixed level in the heater. The combined result was increased flow through the "B" HDP and decreased NPSH which caused the trip of the pump.

CAUSE (continued)

The DEH Control System is designed such that when the plant is operating above 90% thermal power, as sensed by the turbine first stage impulse pressure, loss of either HDP will result in a turbine runback until turbine power is reduced to less than 86%. When the runback occurs, the DEH Control System removes the feedback loops from service and ramps down the reference counter (desired load) at 1900 MW/min. until the runback signal has cleared, at which time it will place the feedback loops back in service. The DEH Control System also ramps the turbine governor valves shut using calculated values (valve management program) at a rate that should match the reference counter. However, experience has shown that the governor valves will ramp shut at a slower rate than the reference counter. When the runback signal clears, and the feedback loops are placed back in service, the DEH Control System will continue closing the turbine governor valves until the reference counter and feedback signals match. This caused the DEH Control System to overshoot the turbine runback setpoints and create a 45% load rejection.

The analysis of the event determined that the DEH Control System functioned properly as designed. However, the control operators were not trained to expect this response during a turbine runback with feedback loops in service. In addition, the operators did not recognize the magnitude of the load rejection. These facts, coupled with the rapid occurrence of events, hindered the operators' ability to stabilize the condensate and feedwater system pressures to prevent the trip of the "B" CBP and "B" MFP.

The operator expected the MFP to automatically trip after the trip of the "B" CBP, but it did not trip. However, the pump did function as designed. Present plant design does not cause an automatic MFP trip upon high CBP discharge pressure. The pump will trip upon low flow or low suction pressure as a result of the loss of the CBP, but these trips have time delays of 5 & 30 seconds respectively. Plant operators are trained to manually trip an MFP following a CBP trip, if it does not occur immediately.

The cause of the trip of the "B" CBP was attributed to high discharge pressure.

Although the highest discharge pressure recorded by the plant computer was 607 psig, (the CBP trip setpoint is 625 psig), the pressure switches that actuate the pump trip could have seen a momentary spike not recorded by the pressure transmitter that feeds the computer. The trip was found to be within the tolerance of the applicable pressure switches.

The cause of the trip of the "A" MFP was attributed to incorrect calibration of the pressure switch for the low suction pressure trip. A post trip review found the switch set at 305 psig instead of the required setpoint of 250 psig.

ANALYSIS OF EVENT:

There were no adverse safety consequences resulting from this event. All plant systems responded as intended, and the plant was stabilized in Mode 3 at normal no load temperature and pressure. Normal steam generator water levels were restored with the Auxiliary Feedwater System (EIIS:BA).

This event is being reported in accordance with 10CFR50.73(a)(2)(iv) as an actuation of an Engineered Safeguards Feature and Reactor Protection System. Previous similar events associated with the loss of Heater Drain Pumps and resulting in reactor trips were reported in LERs 87-019-00, 87-024-00, 87-025-00, and 87-031-00; however, these events are not directly related to this LER because of different root causes for the heater drain pump trip and the concurrent large turbine load decrease.

CORRECTIVE ACTION:

1. Feedwater Heater 3A was opened and inspected. A plywood cover was found inside the heater and was removed. The heater was restored to service.

2. To prevent the overshoot of setpoints during a turbine runback, a design change to the DEH Control System will be considered, which will ensure that the feedback loops, once taken out of service will not be automatically placed back in service.

3. Plant operators will be provided training on the event and the effect of feedback loops on turbine runback conditions.

4. An operations night order was issued that requires the feedback loops to be taken out of service before exceeding 90% power. A change to applicable procedures will be made.

5. Disciplinary action was taken for the personnel responsible for leaving the cover in the 3A Feedwater Heater.

6. A review of the current controls and closure inspections of systems will be conducted.

7. Retraining of applicable maintenance personnel on proper work practices for system cleanliness will be conducted.

ATTACHMENT 1 TO 8812050217 PAGE 1 OF 1

CP&L
Carolina Power & Light Company

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NOV. 29, 1988

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Letter Number: HO-880241 (0)

U.S. Nuclear Regulatory Commission
ATTN: NRC Document Control Desk
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT UNIT 1
DOCKET NO. 50-400
LICENSE NO. NPF-63
LICENSEE EVENT REPORT 88-032-00

Gentlemen:

In accordance with Title 10 to the Code of Federal Regulations, the enclosed Licensee Event Report is submitted. This report fulfills the requirement for a written report within thirty (30) days of a reportable occurrence and is in accordance with the format set forth in NUREG-1022, September 1983.

Very truly yours,

R. A. Watson
Vice President
Harris Nuclear Project

JRJ:dj

Enclosure

cc: Mr. W. H. Bradford (NRC - SHNPP)
Mr. B. Buckley (NRR)
Mr. M. L. Ernst (NRC - RII)

MEM/LER-88-032/1/OS1

END OF DOCUMENT

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